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Research

PhD & MS Abstracts

MS Abstract

The Effect of the Use of Grout Pads on Corrosion Resistance of Sign and Lighting Structures

By

Daniel Duaquaye Darku

University of Florida
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Chairman: Dr. Mang Tia
Co-Chairman: Dr. Ronald Cook
Major Department: Civil Engineering

Tubular high mast poles, roadway light poles and mast arms are typically connected to concrete foundations by annular base plates and anchor bolts using double nut installation. These poles are most often damaged by strong winds and hurricanes. Previous research studies revealed that the damage to the poles are mostly due to relatively high bending moments. The total deflection of the structures comprised of deflection caused by bending of the tubular member plus that caused by the rotation of the base structure with a significant amount of the overall base rotation (30%) being due to the elongation (at tension side) and shortening (at compression side) of the anchor bolts.

The use of a grout pad under the base plate is expected to provide additional support under the plate on the compression side. Currently, the Florida Department of Transportation requires the use of a grout pad beneath all signing and lightening structure base plates. However, several other states have doubt about a possible shortcoming due to maintenance problems.

The goal of this project was to investigate the durability of the base plate arrangements with grout pads. Three test specimens were constructed to replicate the base plate arrangements in the field, one with a grout pad of grout material of low permeability, a second specimen with a grout pad with a grout of higher permeability and a third specimen without any grout pad. The three specimens were duplicated. The specimen were subjected to daily wet-dry cycles in a 3.5% salt solution for 14 weeks . During this period, the corrosion of the embedded bolts and nuts were electrochemically monitored every two weeks using the linear polarization resistance technique with a guard ring electrode configuration. Visual observations were made of the embedded bolts, nuts and the base plates of the specimens at the end of the wet-dry cycling. Weight loss measurements were also made.

The electrochemical corrosion measurements were interfered by the presence of the zinc coated base plate, correlation of the results with the visual observations and weight lost measurements could therefore not be made.

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Summary

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The visual assessments and weight loss measurements revealed that the use of grout pads under the base plates improved the durability of the base plate assembly by enhancing the corrosion resistance of the embedded anchor bolts, nuts and the base plate. There was no significant difference in the corrosion protection of the anchor bolts by the two grout types used in the experiment.

Design Standards
June 1997
Exterior Lighting
PART 1 - GENERAL

DIVISION 16 - ELECTRICAL
Sectio

1.01 Integrated Design: Every effort should be made by the designer to incorporate the psychological aspects of the visual environment into the design, selection and installation of exterior lighting systems. The equipment and its visual effects must be considered as integral parts of the overall landscape and, as such, close attention must be paid to location, equipment appearance (in both the lighted and non-operational states), and the visual environment created during operation. The ability to see the night sky, including stars and auroras, is an important part of the Alaskan experience and that exterior lighting should be designed with this in mind. Minimizing **light** pollution is mandatory.

1.02 These standards and policies for lighting shall hold in general with the

understanding that particular situations, structures, or buildings, may suggest or require variation. The standards shall not be construed to inhibit different or innovative lighting for superior aesthetic qualities being proposed for specific projects. Further, **light** Minimizing maintenance and operational costs should be considered as one area of the overall design process.

1.03 All areas generally used by pedestrians, including walks, plazas, malls, and parking lots, shall be adequately lighted for safety and convenience, and in a manner appropriate for pedestrian places.

1.04 Roads, drives, and service areas shall be adequately lighted for safety and

convenience, in a manner appropriate for motor vehicles.

1.05 Generally speaking, lights for pedestrian ways shall be a maximum of 100' apart.

For roadways, a maximum of 200' apart.

1.06 Lighting by directing lights at buildings shall be avoided unless for aesthetic effects

or safety measures.

1.07 Luminaries shall be of a uniform design throughout campus unless a specific function (such as ski trail lighting) requires a special design. Luminaries shall incorporate sharp cut-off distribution characteristics to minimize glare and **light** pollution.

1.08 Exterior Lighting systems shall utilize high pressure sodium vapor, metal halide, fluorescent or other long-life lamp types.

1.09 Require vandal protection for all exterior lighting.

1.10 Where practicable, appropriate, and aesthetically possible to harmonize with the architecture, exterior lighting shall be incorporated on buildings.

1.11 Free standing **light** posts shall be of a uniform design throughout campus, 25'-35' high along streets and parking lots, 12'-15' high in or along pedestrian ways.

1.12 Covered walks, stairs, or ramps shall incorporate lighting.

1.13 All wiring shall be underground.

1.14 Illumination Levels: Levels of illumination for parking lots and road way lighting shall be those defined in Illuminating Engineering Society Standards, current editions.

1.15 Mounting Heights: Due to the relatively low profile established for the campus, the maximum mounting heights for exterior lighting luminaries as shown in the table below should not be exceeded.

MINIMUM LUMINAIRE MOUNTING HEIGHTS

APPLICATION	*MINIMUM HEIGHT
Roadways	35" - 0" Above Grade
Pathways, Bike paths	25" - 0" Above Grade
Residential Areas	20' - 0" Above Grade

Note: The indicated heights include any projections or bases above grade where pole mounted fixtures are used.

1.16 Selection of Lighting Sources (lamps): Due to various factors such as efficiencies,

cold weather characteristics and operational characteristics, only one type of source will be considered, high-pressure sodium.

Incandescent, fluorescent, or low-pressure sodium lamps shall not be used for exterior lighting applications. Sources other than high-pressure sodium shall be evaluated on an individual basis when proposed for use.

All sources shall be provided with proper auxiliaries (ballasts, starting aids, etc.) to insure proper starting and operation within the temperature ranges to be encountered (+120EF to -60EF). Heated lamp enclosures, early starting or other

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such techniques shall not be used, unless specifically approved in writing by an

authorized representative of the University of Alaska.

1.17 Minimum Requirements for Equipment and Components: The following criteria

shall be applicable to all new lighting equipment and components regardless of whether part of a new lighting system, installed to augment existing lighting, or (where practicable) replacing existing equipment or components:

A. Fixture Types

1. Sharp cut-off distribution type, NEMA type II or type V distribution, suitable for the application.

2. U.L. listed and labeled for "wet" locations.

3. Low profile architectural "shoebox" type. **Light** to be directed downward.

4. Heavy duty aluminum construction with integral Aluminum Association, Class 1, 0.7 mil minimum thickness, architectural anodic finish.

5. High-pressure sodium lamps with maximum and minimum wattage of 250" and 50" mogul **base**.

B. General:

1. Auto-regulated high power factor (0.9) encapsulated ballast auxiliaries for starting and operating lamp in temperatures down to -60EF.

2. Ballast, starter, and auxiliaries mounted on a unitized "balla tray" with plug-in connectors for quick disconnect, removal and replacement of ballast tray and components without opening the lamp compartment.

3. All gaskets neoprene or closed- cell urethane.

4. Optically clear, tempered glass lens, heat and impact resistant, in aluminum frame. Lens shall be horizontal and have no vertical component.

Exterior Lighting

5. Provide with house-side shields for building mounted units.

6. Concealed positive stainless steel latches with stainless stee hinges on doors.

7. Low surface brightness.

8. No exposed fasteners.

9. All hardware stainless steel or cadmium plated steel.

10. Aluminum reflectors and refractors.

11. Internal wiring rated minimum 600 VAC and 150EC. Field wiring terminals shall be rated minimum 600 VAC and be capable of accepting up to #6 AWG.

C. Mounting

1. Where practicable and suitable for the application, provide building mounted fixtures. Provide pole mounting elsewhere.

2. Mounting hardware, fasteners, and methods shall support we of luminaire plus snow loads and shall be designed to withstand winds of 125 mph with 1.3 gust factor and where applicable, the impact of falling ice. A minimum safety factor of 2.5 shall be used in selecting mounting methods, hardware, and fasteners.

3. All hardware and fasteners shall be stainless steel or cadmiu plated steel. All hardware and fasteners shall be concealed wherever possible. If hardware or fasteners must be exposed, provide tamper-proof vandal-resistant type.

4. All metallic non-current-carrying parts shall be bonded and grounded.

5. Power actuated anchors and fasteners shall be used only wh approved in writing by an authorized representative of the University of Alaska.

6. **Poles** for pole mounted units shall be heavy-wall aluminum with

integral Aluminum Association, Class 1, 0.7 mil minimum thickness, architectural anodic finish or approved equal. **Poles** shall have reinforced bases to withstand 135 mph wind loading with 1.3 gust factor when entire assembly is installed on the pole's footing (**base**). Finishes of **poles** shall match finishes of fixtures attached.

7. All **poles** shall be fixed **base** type with four anchor bolts per pole.

All anchor bolts shall be double- nutted to facilitate pole alignment and adjustment. All **base plates** and anchor bolts sha be configured for 11" bolt circle diameter with 1" diameter anchor bolts.

8. All **poles** shall have a 3" x 5" (minimum) handhole with gasketed

cover plate located up to 18" to centerline of handhole above bottom of **base** plate. Cover **plates** shall be securely fastened to pole with minimum of four tamper-proof screws.

9. All **poles** shall have a grounding lug capable of accepting up to

#4 AWG. All raceways, pole **base**, pole and other non-current-carrying parts shall be bonded together and grounded to this lug The bonding jumper shall, in no case, be smaller than #10 AWG copper.

10. All **poles** shall be provided with a heavy-wall aluminum **base**

plate cover concealing anchor bolts and pole **base** plate or approved equal. This pole **base** cover shall be securely anchored to the pole **base** and shall be finished to match the pole. The cover shall be sufficiently deep to rest on top of the surface of th concrete pole **base** from which the anchor bolts project.

11. All **poles** shall be mounted on reinforced concrete foundations

designed and constructed to resist all loads and forces imposed on the foundation/pole/luminaire assembly in conjunction with the encountered soils conditions. Concrete shall be 3000 psi at 28 days. Rebar shall be minimum #8 with 2" minimum distance from centerline of any rebar to surface of concrete. When

from centerline of any rebar to surface of concrete. When requested by the University of Alaska, copies of calculations shall be submitted.

1.18 Controls:

A. Exterior lighting shall be switched "on" and "off" by photocell.

1. Photocells have a fairly high mortality rate. Locate each photocell so it may be easily maintained and replaced.

2. All photocells shall be located and shielded so incidental stray **light**, headlights from vehicles or other interfering sources of **light** do not cause improper operation of the controlled unit(s)

3. All photocells shall be adjusted so all exterior lighting is switched "on" or "off" simultaneously.

4. Photocell may directly control branch circuits with a total connected load equal to or less than 80% of the photocell's rated volt-amp capacity at rated voltage.

5. Where one photocell controls multiple branch circuits or a single circuit that exceeds the criteria in 4. above, the photoce shall control the exterior lighting through a lighting contractor

B. A Hand-Off-Auto switch shall be provided in each control arrangement.

1. The Hand position shall bypass the photocell and turn "on" th lighting normally controlled by the photocell.

2. The Off position shall bypass the photocell and turn "off" the lighting normally controlled by the photocell.

3. The Auto position shall cause the lighting to be turned "on" and "off" by the photocell.

4. Provide a pilot **light** (illuminated when lighting is "on") for each control circuit.

C. Lighting contactors

shall be rated for the connected loads and be of prop configuration for the number of circuits connected plus a minimum of 25% spare **poles**, but in no case shall less than one spare pole be provided in each contactor.

1. All contactors shall be mechanically held, electrically operate

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2. All contactors shall be mounted in NEMA enclosures suitable for the environment in which installed.

3. H-O-A switches and pilot lights shall be mounted in contactor covers.

D. All

equipment, components, and wiring shall be identified.

1. Provide engraved plastic nameplates affixed to enclosure

covers, switchplates, component housings, etc., identifying th equipment, its function, and the system or location with which associated.

2. Label all conductors with durable laminated wrap-on labels

identifying where originating and where terminating.

identifying where originating and where terminating.

3. Color code all conductors in accordance with the NEC.

PART 2 - PRODUCTS

2.01 Lamps shall be high pressure sodium type for efficiency and cold weather characteristics. Maximum and minimum lamp wattage to be 250W H.P.S. and 50 H.P.S. mogul **base**.

PART 3 - EXECUTION (NOT USED)

END OF SECTION